RCx Made Easy: New Tools to Calculate RCx Energy Savings

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A Brief History of SCE’s RCx Program

• SCE’s 06-08 RCx Program ran from 2006 to end of 2009
• Both gas and electric (joint program with Southern California Gas)
• PECI served as the program implementer
• Program focused on operational measures (controls, scheduling, minor retrofits) with energy benefits
• Program paid for screening, investigation and follow up services
• Participant paid for implementation. Program paid financial incentives to buy down implementation for measures over a year in simple payback
• Program is continuing into the new, 2010-12 cycle
How Does SCE’s RCx Work?

- Building owner submits application
- PECI screens building for compatibility
- PECI contracts with RCx Service Provider
- Service Provider investigates building
- Service Provider reports back to SCE with measure analysis and M&V data
- Owner implements measures, SCE pays financial incentives
- Service Provider delivers inspection and training
SCE’s 06-08 RCx Program By the Numbers

17 Million kWh

$8.5 Million

1.1 Peak MW

100,000 SF Minimum Building Size

209 Applications Received

28 Million SF Investigated

113 Investigations Completed

59 Completed Projects
SCE’s 06-08 RCx Program By the Numbers

47
SCE’s 06-08 RCx Program By the Numbers

14
The California Public Utilities Commission requires a Process Evaluation for all EE programs.

A process evaluation looks at and reviews qualitative aspects of a program.

Research Into Motion and ASW Engineering conducted a Process Evaluation released in May 2009.
Key Findings

- RCx Providers are not providing consistent, adequate, explanatory data
- RCx Providers are frustrated with the review process and want more compensation
  - “It’s way too much rigor that is required. It provides the appearance of more rigor without more rigor.”
  - “Any time you have two engineers look at a problem they will come up with two different approaches.”
  - “It took five or six weeks for the review of findings. The findings were returned with comments. I addressed the comments, then it took another five or six weeks for further review. It took six months to get our first payment.”
- There is a need to streamline the process so that it is less burdensome to the Service Providers
Recommendations

- Standardize service providers’ energy savings calculations and conduct guiding workshop(s)
- Establish minimum level of baseline data collection
- Create a multi-tier protocol for analysis rigor based on impact
Assembled experts to address the recommendations:
  - ASW – Process Evaluator
  - PECI – Program Implementer
  - AESC – Internal Quality Control
  - SCE M&V and Program Staff
  - SCG M&V and Program Staff

Held workshops to discuss implementation

Particularly keen on the multiple-tier approach
74% of all measures are under 75,000 kWh

Measures under 75,000 kWh make up only 27% of all program savings
Two-Tier Calculation Approach

TIER I (optional) for measures < 75,000 kWh or < 30% of building gas consumption
- Commonly occurring measures
- M&V pre- and post-requirements
- Energy savings are pre-calculated / deemed based on several input parameters

TIER II - Mandatory for measures > 75,000 kWh
- All measures
- M&V pre- and post-requirements
- Energy savings go through full, customized analysis
Advantages of a Pre-Calculated Approach

- Reduced overall project costs
- RCx provider can spend more resources in the field rather than in the office
- Reduced quality control costs
- Faster approval time
- Allows for a “mass-market” approach
Looking Into the Future

• Retrofit vs RCx
• So far, RCx is typically a “niche” program, need to make it “mass market”
• Utilities need to increase their participation in this market, standardizing is one of the keys
• Some RCx measures are no-brainers, and they should be treated as such, don’t get hung up with numbers
• RCx is a first step, the rest is behavioral that requires training, better documentation, follow up, etc.
Making the Case for Simplification

“When it comes time to do energy savings calculations, I feel like a kid in school being tested. It’s stressful.”

- A veteran RCx provider

http://cdn.sheknows.com/articles/boy-taking-exam.jpg
Solution: Simplified Savings Calculation Tool

“BOA Tool”

- **Building Optimization Analysis Tool**

Targeted at typical non-residential building types with typical HVAC systems

- Those found in most RCx projects

[ UIImage ]

![Image 1]

http://www.treehugger.com/glass-box.jpg

![Image 2]

http://liviaandbilly.files.wordpress.com/2010/01/emp.jpg
Eleven HVAC Measures Included in Tool

Airside
- Reduce supply fan operating schedule
- Add supply air temperature reset
- Reduce supply duct static pressure
- Reset supply duct static pressure
- Add supply fan VFD
- Adjust zone temperature deadband
- Adjust airside economizers

Waterside
- Add boiler lockout
- Add chilled water supply temperature reset
- Add condenser water supply temperature reset
- Add chilled water pump VFD
Two Lighting Measures Included in Tool

- Reduce lighting operating schedule
- Add occupancy sensors for lighting control

- More HVAC than lighting measures
  - Most RCx measures in California utility RCx programs are HVAC-related
Simplified user interface accesses complex calc results

- Spreadsheet-based interface
  - Prompts users for a few basic inputs
- Software applies inputs to “pre-calculated” results from DOE-2 runs to calculate savings
  - Parametric eQuest runs were used to develop the pre-calculated savings factors

A “prescriptive” approach
DEER = California’s Database for Energy Efficient Resources

- Deemed energy savings values for efficiency measures
  - Based on building type, building vintage, and climate zone
- Includes some of those 13 measures already

BOA Tool has more project-specific inputs

- For more project-specific savings estimates
What are the User Inputs?

Sensitivity analysis performed

- To determine the most significant variables, which become the tool inputs

![Sensitivity Analysis - SAT Reset](chart.png)
What Building Types are Covered by the Tool?

Most common types found in RCx

- Large Office, Large Retail, Hotel, Hospital, Education
- Tool uses DEER baseline building types and building vintages, in California’s 16 climate zones
  - Representative of typical building construction, HVAC systems, etc.
## BOA Tool Interface: General Inputs

### General Inputs

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Office - Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zip Code</td>
<td>90210</td>
</tr>
<tr>
<td>CA Climate Zone</td>
<td>9</td>
</tr>
<tr>
<td>Year Building Constructed</td>
<td>1985</td>
</tr>
<tr>
<td>Facility Gross Area (ft²)</td>
<td>100,000</td>
</tr>
</tbody>
</table>

### Baseline Building Energy Use

<table>
<thead>
<tr>
<th>Baseline Annual Electric Use (kWh)</th>
<th>1,400,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Annual Gas Use (Therms)</td>
<td>40,000</td>
</tr>
<tr>
<td>Electric EUI (kWh/ft²)</td>
<td>14.0</td>
</tr>
<tr>
<td>Gas EUI (therms/ft²)</td>
<td>0.4</td>
</tr>
<tr>
<td>Total EUI (kBtu/ft²)</td>
<td>87.8</td>
</tr>
</tbody>
</table>

User input in yellow cells

Baseline usage used for error checks in measure tabs
### BOA Tool Interface: Measure-specific Inputs

**Airsde economizer example**

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Non-discrete inputs</th>
<th>Discrete inputs as pulldown menus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Type</td>
<td>Office - Large</td>
<td></td>
</tr>
<tr>
<td>CA Climate Zone</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Year Building Constructed</td>
<td>1985</td>
<td></td>
</tr>
<tr>
<td>Lock-Out Temperature or % Outside Air</td>
<td>55 Deg Lockout</td>
<td></td>
</tr>
<tr>
<td>Air Handler Cooling Capacity (tons)</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

In this example, tool looks up savings factor for:

- Large Office
- California climate zone 9
- 1985 vintage building
- 55°F baseline economizer lockout temperature
**BOA Tool Interface: Measure Savings Outputs**

*Airsde economizer example*

**Savings =**  
(pre-calc’d savings factor)*(non-discrete inputs)  
- E.g., $(281.4 \text{ kWh} / \text{ton}) \times (200 \text{ tons}) = 56,281 \text{ kWh}"

<table>
<thead>
<tr>
<th>Savings Outputs</th>
<th>Value</th>
<th>% of Annual Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Electric Savings</td>
<td>56,281 kWh/yr</td>
<td>4.0%</td>
</tr>
<tr>
<td>DEER Peak Electric Demand Savings</td>
<td>0.1 kW</td>
<td></td>
</tr>
<tr>
<td>Annual Natural Gas Savings</td>
<td>0 Therms/yr</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

*Warnings and Errors: No warnings or errors exist for this measure*

Warnings / errors if savings are too high:
- For use of tool in utility program (e.g., >75,000 kWh)
- Compared to whole building usage
BOA Tool Strengths

Easy-to-use

- Only a few inputs required
- Immediate results
- Should give providers time to identify more measures / savings
- Should help streamline review process

Includes most common RCx measures and applies to most common building types
BOA Tool Limitations

Applies only to certain building types and baseline / measure conditions
Includes only common, simple measures

- Other building types, measure conditions, and measure types will require a custom analysis
  - E.g., spreadsheet calc, DOE-2 model
Future Versions of BOA Tool

More building types
  • Target smaller buildings

More measure types

Embed energy simulation engine in tool
  • Instead of parametric run look-ups
  • Would increase applicability of tool
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Pacific Gas & Electric
Challenges Facing Commissioning

Market Adoption

• Cost & Mindshare
  ○ $1.00 / sq ft.
  ○ Re-active maintenance

• Awareness

![Graph showing GWh for Savings, Pipeline, and Available Market for SCE and PG&E]
Ramping up the market curve

Extending Market Penetration with BOA

- Decrease time and cost for baseline analysis and calculated savings
- Increase reviewer confidence and consistency

Market success with BOA

- Increase overall Cx consistency / accuracy
- Decrease persistence issues with annual follow-ups
- Continued update of BOA to expand market
Questions?

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